

FRED Reports

RESULTS OF PINK SALMON (*Oncorhynchus gorbuscha*)
FRY TRANSPLANTS TO HOBO CREEK,
PRINCE WILLIAM SOUND, ALASKA

BY

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Number 33



Alaska Department of Fish & Game
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ABSTRACT

In 1980, 1.7 million pink (Oncorhynchus gorbuscha) salmon fry from Jonah Creek Stock, which had been incubated at the Port San Juan Hatchery, were transported to and released in Hobo Creek. In 1981, 7 million fry from Port San Juan stock, which had been incubated at the Cannery Creek Hatchery, were released at Hobo Creek to complete a transplant to establish a self-sustaining run above a barrier falls that had been laddered.

Adult returns to Hobo Creek were monitored to evaluate the success of fry transplants. Approximately 7,000 and 4,200 adult pink salmon returned to Hobo Creek in 1981 and 1982, respectively. Adult returns to the incubation sites are also discussed.

The fry transplants have been successful in establishing a pink salmon run at Hobo Creek. An estimated 11,850 adults returned to the stream in 1983 as a result of natural spawning by adults returning from the 1980 fry transplant.

Key words: pink salmon, Oncorhynchus gorbuscha, fry transplants, salmon imprinting.

INTRODUCTION

Hobo Creek is located on the western shore of Port Wells (lat. 148° 13' W, long. 60° 57' N) in the northwestern sections of Prince William Sound (Figure 1). The stream has supported small runs of pink (Oncorhynchus gorbuscha), chum (O. keta), and coho (O. kisutch) salmon. A velocity barrier at the stream terminus, however, has prevented the natural establishment of large populations of salmon. Returning adult salmon have depended on infrequently favorable waterflow conditions to negotiate the velocity barrier. In most years, pink salmon are unable to ascend the velocity barrier to enter the stream.

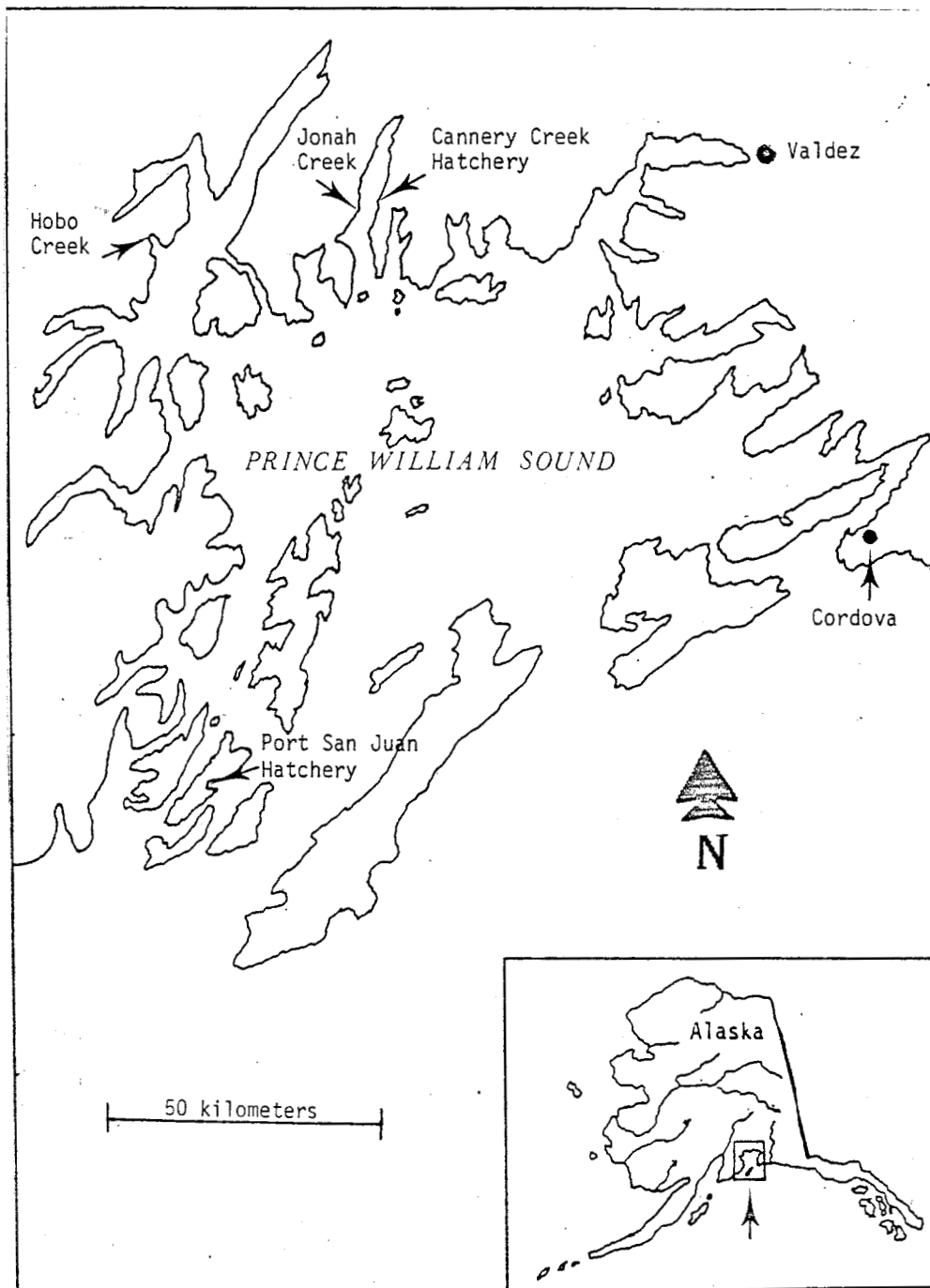


Figure 1. Location of key sites relative to the Hobo Creek salmon stock development project, Prince William Sound, Alaska.

In 1978 the Hobo Creek fishway was constructed under a contract administered by the U. S. Forest Service (USFS). The fishway incorporates a single run 6.1-m-long steep pass of Denil design [described by Ziemer (1962)] with a 12.2-m-long water diversion structure near the upstream exit. In 1979 the Alaska Department of Fish and Game, Fisheries Rehabilitation, Enhancement, and Development Division (FRED) initiated pink salmon fry transplants to Hobo Creek in an attempt to develop a viable run of pink salmon that would utilize approximately 4.8 kilometers of prime spawning habitat above the velocity barrier.

This report summarizes the 1979 and 1980 brood year pink salmon fry transplants to Hobo Creek and the resulting adult returns.

METHODS

In 1979 pink salmon eggs were obtained from adults returning to Jonah Creek (Figure 1). Eggs were fertilized on site, water hardened, and transported to Prince William Sound Aquaculture Corporation's (PWSAC) Port San Juan Hatchery for incubation. The 1980 eggs were taken at Port San Juan, incubated to the eyed stage, and transported to Cannery Creek Hatchery for incubation to the fry stage (Figure 1). Prior to transport, a portion of the fry were marked by the removal of one or more fins. In both 1980 and 1981, the fry were transported by the Alaska Department of Fish and Game vessel, Montague. The 6,435-l bait hold was filled with fresh water and fry. Oxygen was supplied through two large airstones at 1-5 liters per minute; the amount of oxygen provided was directly proportional to the number of fry transported. On arrival at Hobo Bay, the fry were transferred into net pens, which were anchored in salt water off the mouth of the stream, and were held for 1 to 4 days prior to release.

To evaluate adult returns, periodic foot surveys were made along the stream bank to count the spawning fish and to assess the distribution of fish in the stream. These surveys covered the main channel of Hobo Creek from the

top of the tidewater falls to an impassable falls, approximately 4.8 kilometers upstream, as well as the significant side channels and tributaries.

The presence of marked fish in the 1981 return was determined by sampling returning adults in Hobo Creek. A beach seine was used to collect fish in sections of the stream where spawning activity was concentrated. After surrounding a group of fish with the seine, field workers examined each fish. The total number of fish as well as the number of fish with fin marks were then recorded. In order to catch the maximal number of fish possible, subsequent sets of the seine were made with minimal spatial overlapping. The results of this sampling were combined to give a single value to the proportion marked in each day's sample.

Carcasses of spawned pink salmon were examined for fin marks each day beginning on 29 August. Dead fish were removed from the water or stream bank and cut in half to prevent repeated counting. The total number of marked fish among the examined carcasses provided another estimate of the proportion of marked fish in the return. A best estimate for the proportion of marked fish (P_w) was calculated as a weighted sum of the various estimates, with weights assigned according to the variance of the individual estimates.

No mark recovery program was conducted at Hobo Creek in 1982 because of personnel and budgetary shortages. The peak ground count was used as the total escapement.

Hatchery sales fish at Port San Juan, which was the 1979 incubation site, were subsampled for marks as they were loaded aboard tenders, and broodstock was checked as well during the egg-take process. The number of "Hobo Creek" pink salmon returning to Port San Juan was estimated using the formulas (Reed 1981; Howe 1982):

$$\hat{Q} = \frac{H}{n_1} \frac{E}{n_3} m_3$$

$$\text{Var}(\hat{Q}) = \left[\frac{H}{n_1} \frac{E}{n_3} \right]^2 \text{Var}(m_3)$$

Where:

\hat{Q} = Estimated number of Hobo Creek fish returning to Port San Juan
E = Number returning to Port San Juan
H = Number of fish released
n1 = Number marked
n3 = Number examined in E
m3 = Marks recovered in n3
var (m3) - see Reed (1981) or Howe (1982) for formula.

The returns to the 1980 egg-take site, Port San Juan, were determined in the same manner as the 1979 brood. In addition, adults returning to the Cannery Creek Hatchery were examined for marks to estimate the number of adults straying back to the incubation site from the 1981 transplant.

RESULTS

Fry Transport and Releases

Four trips were made to transport the fry from Port San Juan to Hobo Creek in 1980 (Table 1). Fry were on board the Montague for approximately 8 hours per trip; the total mortality was visually estimated at less than 1%. Of the estimated 1.7 million fry released, 30,650 were marked with an adipose clip.

Table 2 shows the results of the 1981 fry transport from Cannery Creek to Hobo Creek. Fry from the first transport were held and fed OMP starter mash for 3 days prior to release. The final three transport lots were not fed. Of the 7 million fry released, 30,000 were marked with an adipose, right ventral clip.

Table 1. 1980 Hobo Creek pink salmon fry transport summary.

Transport Date	Total Fry Weight (kg)	Transport Density (g/liter)	Estimated Number of Fry Transported	Estimated Transplant Mortality
04/15/80	63.5	9.87	340,540	<1.0%
04/28/80	92.0	14.30	493,880	<1.0%
05/07/80	96.4	14.98	517,580	<1.0%
05/22/80	64.0	9.96	343,400	<1.0%

Table 2. 1981 Hobo Creek pink salmon fry transport summary.

Transport Date	Total Fry Weight (kg)	Transport Density (g/liter)	Estimated Number of Fry Transported	Estimated Transplant Mortality
04/16/81	397.0	61.46	1,900,000	<1.0%
04/22/81	397.6	61.78	2,000,000	<1.0%
04/29/81	552.0	85.78	2,800,000	<1.0%
05/07/81	47.5	7.38	250,000	<1.0%

Adult Returns to Hobo Creek

Adult pink salmon entered Hobo Bay on or shortly before 26 July 1981. Prior to this date schools of several hundred fish were regularly observed in shallow waters at low tide, occasionally moving into the stream mouth during flooding tides and then retreating. On 10 August, more large schools of fish were observed in shallow water in Hobo Bay. These silvery fish appeared to be more recent arrivals, since most fish observed until this time had typical spawning coloration and appearance.

During a foot survey on 4 August, adult pink salmon were first observed in the stream. At that time, eight pink salmon were counted; all were within .8 kilometers of the fish pass. Fish were first observed using the fish pass on 10 August when two fish were passed through the weir. Observation of fish moving over the tidewater cascade from 10 to 17 August revealed that for every fish using the fish pass, 10 to 15 did not. Poor visibility during frequent flood conditions prevented precise counting of fish moving over the cascade.

From the peak live count of 6,519 (Table 3), 431 carcasses, and 50 remaining in the tidewater as of 2 September 1981, an estimated 7,000 pink salmon returned to Hobo Creek.

An estimated 1.0% of the total return, or 71 fish (± 27 @ 95% C.I.), were marked. Results of the various methods to assess the proportion of marked fish are given in Table 4. No marks other than the missing adipose fin were observed.

Calculation of the survival rate of marked fry returning to Hobo Creek is:

$$\hat{S}_m = \frac{71 \text{ estimated marked fish returning to Hobo Creek}}{30,658 \text{ marked fry released at Hobo Creek}} \times 100 = 0.2\%$$

with lower and upper ranges estimated at 0.1% and 0.3%, respectively, based on 95% confidence limits.

Table 3. 1981 Hobo Creek escapement counts: foot surveys.

Date	Pink Salmon	Chum Salmon	Coho Salmon	Sockeye Salmon
8/04	8	-	-	-
8/17	384	4	5	-
8/23	1,251	-	-	-
8/25	2,522	-	6	-
8/30	5,717	15	15	15
9/02	6,519	17	25	15

Date	Source	Number of Fish Examined	Number Marked	P
10 Aug - 1 Sep	Weir Trap	89	1	.0112
28 Aug	Seine	296	2	.0068
29 Aug	Seine	754	8	.0106
30 Aug	Seine	69	1	.0145
1 Sep	Seine	968	10	.0103
29 Aug - 3 Sep	Carcasses	530	6	<u>.0113</u>
			$\bar{P}_w \underline{a/}$	= .0101
				($\pm .0038$ @ 95% C.I.)

Sample	N	Marks	\hat{p}	$V_{\hat{p}} = \frac{\hat{p}(1-\hat{p})}{N}$	$1/V_{\hat{p}}$	$W_i = \frac{1/V_{\hat{p}}}{\sum 1/V_{\hat{p}}}$
1	89	1	.0112	.0001248	8011	.029582
2	296	2	.0068	.0000227	44106	.162869
3	754	8	.0106	.0000139	71826	.265229
4	69	1	.0145	.0003070	4831	.017839
5	968	10	.0103	.0000106	94680	.349622
6	530	6	.0113	.0000211	47353	.174859

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Table 4. Continued

$$\bar{P}_w = \sum_{i=1}^6 W_i P_i$$

$$\sum 1/V_P^{\hat{}} = 270807 \quad \sum W_i = 1.00$$

$$\begin{aligned} &= (.029582) (.0112) + (.162869) (.0068) + (.265229) (.0106) + (.017839) \\ &\quad (.0145) + (.349622) (.0103) + (.174859) (.0113) \\ &= .0101 \quad 11 \end{aligned}$$

$$V_P^{\hat{}} = \sum_w W_L^2 \quad 1/P_L = .0000370$$

The rate of return for total released fry is given as:

$$\hat{S}_t = \frac{7,000 \text{ adult returns to Hobo Creek}}{1,695,400 \text{ total fry released}} \times 100 = 0.4\%$$

At the time of the final foot survey, spawning pink salmon were observed throughout the accessible length of Hobo Creek. Approximately 250 fish were observed within 300 meters of the impassable falls that marked the upstream limits of the survey. Most fish, approximately 6,200, however, were in the first 3.2 kilometers of the stream above the fish pass, where they were distributed evenly among sections with favorable spawning habitat.

Commercial fishing in the area, including Hobo Bay, ended by emergency order closure on 27 July 1981. Prior to this date, no tenders had been observed operating in water accessible to field personnel at Hobo Bay. Since the commercial catch in the vicinity of Hobo Creek was not checked for the presence of marked fish, no estimate of the contribution to the fishery was possible.

The peak ground count of 4,214 pink salmon on 21 August 1982 was estimated as the total escapement to the transplant site. No mark recovery was conducted in either the escapement or the fishery in the Hobo Bay area.

Adult Returns to the Incubation Sites

A total of 893,300 adult pink salmon returned to Port San Juan in 1981. Approximately 315,300 were examined for marks, and 317 fish with adipose clipped fins were recovered (only Hobo Creek fish had this mark). The 1981 return of pink salmon to the Port San Juan Hatchery (incubation site), as a result of the 1980 fry transplant to Hobo Creek, was estimated at 49,700 ($\pm 5,400$ @ 95% C.I.).

Returns to Cannery Creek are composed of the following components: (1) Cannery Creek fish released at the hatchery; (2) Cannery creek fish transported to Hobo Creek that strayed back to the hatchery. This latter component is then sub-divided into: Hobo Creek strays returning to the hatchery and taken in the fishery, and Hobo Creek strays used as broodstock and escapement. In 1982, approximately 1,376,800 pink salmon were caught in the vicinity of the Cannery Creek Hatchery. Of these, 145,175 were examined for marks, and eight adipose, right ventral clips were recovered. Based on this, the catch of Hobo Creek releases bound for the Cannery Creek incubation site was estimated at 17,550 ($\pm 12,150$ @ 95% C.I.). Also in 1982, 71,600 pink salmon were used for broodstock and escapement for Cannery Creek Hatchery. Approximately 62,700 of these were examined for marks, and eight adipose, right ventral marks were recovered. Based on this, the number of Hobo Creek releases in the return to the hatchery was estimated as 2,100 ($\pm 1,450$ @ 95% C.I.).

During the 1982 season, 1,951,000 pink salmon returned to the egg-take site at Port San Juan. Of these, 251,763 were examined for marks; only one adipose, right ventral mark was recovered. This was considered insufficient to attribute a portion of the return to fry transplanted to Hobo Creek.

Total Adult Returns

The estimated 1981 total return from pink salmon fry transplants to Hobo Creek was 56,700 pink salmon, of which 7,000 (12.4%) returned to the transplant site and 49,500 (87.6%) returned to the incubation site. Total fry to adult survival (based on adult return estimates) was 3.3%.

The estimated total transplant return in 1982 was 23,868 pink salmon, of which 4,214 (17.7%) returned to the transplant site, 2,111 (8.8%) returned to the incubation site, and 17,543 (73.5%) were caught in the commercial fishery associated with the incubation site. Marine survival (based on adult return estimates) was 0.3%.

The calculated survival percentages are underestimates of the actual marine survival because (1) the estimates are based on marked recoveries and are not corrected for possible differential survival between marked and unmarked fry, and (2) the estimates do not take into account commercial fisheries interceptions. Before the 1964 earthquake, the odd-year returns were dominant. Since then, however, pink salmon dominance in the odd or even year has not been determined, but we assume that the low survivals of the 1980 hatchery returns were not due to this phenomenon.

DISCUSSION

The primary objective of this project was to establish a self-sustaining run of pink salmon to Hobo Creek through fry transplants. The transplant was effective since adult pink salmon returned to Hobo Creek and spawned successfully.

The escapements into Hobo Creek in 1982 were somewhat disappointing, considering the larger number of fry transported, but the percentage straying back to the incubation site was much lower: 33.4% as compared with 87.6% in 1981.

It is of special interest to note that no significant straying back to the egg-take site occurred in 1982. The major differences in the 2 years were (1) egg-take site, (2) incubation site, and (3) brood source. In the 1979 brood year, eggs were taken at Jonah Creek and incubated to the fry stage at Port San Juan. In the 1980 brood year, eggs were taken at Port San Juan from returns of introduced pink salmon, incubated to the eyed-egg stage, and then transported to Cannery Creek for incubation to the fry stage.

The 1979 brood year transplant provided the greatest escapement to the transplant site despite the much higher degree of straying to the incubation site. Although the fishery interception rate was not determined, the average interception for Prince William Sound was very similar in both years (87% in 1981 and 89% in 1982).

A similar transplant of pink salmon fry was completed in Prince William Sound in 1980. For this transplant, eggs were taken from adult pink salmon in Cannery Creek, incubated at Port San Juan Hatchery, and returned to Cannery Creek as emergent fry. The cannery Creek transplant differed from the Hobo Creek transplant in two ways: (1) the transplanted fry were released into the parent system, and (2) the fry were planted in fresh water and allowed to migrate to sea volitionally. Of the total estimated number of adults returning as a result of the Cannery Creek transplant, 99% returned to the release site (Cannery Creek) and 1% returned to the incubation site at Port San Juan (McDaniel and Kohler 1982). The total estimated return for the Cannery Creek transplant was calculated from marked fish recoveries at Cannery Creek and Port San Juan. In a study conducted on Afognak Island, Alaska, using techniques similar to the Cannery Creek transplant, less than 1% of the estimated adult return strayed back to the incubation site (McDaniel 1981).

Preliminary results of the Hobo Creek transplant indicate that genetics and imprinting are important components in the homing mechanism of pink salmon. Obviously, where indigenous stocks do not exist, donor stocks must be used for enhancing salmon runs. In these cases, some straying of adults back to the incubation site is to be expected. Planting of transplanted fry well upstream in the recipient stream may reduce straying of adults back to the incubation site and possibly back to the donor (parent) stream.

In 1983, pink salmon escapement into Hobo Creek was monitored by periodic aerial surveys that were conducted by personnel from the Division of Commercial Fisheries. Based on eight surveys, the total seasonal escapement was estimated at 11,850 pink salmon. Good distribution of spawning salmon above the barrier falls was observed. The 1983 adult return was the first return to Hobo Creek as a result of natural instream spawning.

REFERENCES

- Howe, A. 1982. User's guide to Basic programs for the design and analysis of evaluation projects. FRED Division, Regional Manuscript.
- McDaniel, Tim R. 1981. Evaluation of pink salmon (Oncorhynchus gorbuscha) fry plants at Seal Bay Creek, Afognak Island, Alaska. Alaska Department of Fish and Game Informational Leaflet 193: 9 p.
- McDaniel, Tim R., and Tom Kohler. 1982. Cannery Creek Hatchery evaluation, 1982 annual project report. Alaska Department of Fish and Game. Unpublished: 10 p.
- Raj, Des. 1968. Sampling theory. McGraw-Hill, Inc. 302 p.
- Reed, D. 1981. Mark recovery in a single fishery of single year returns. FRED Division. Unpublished manuscript. 8pp.
- Ziemer, G. L. 1962. Steeppass fishway development. Alaska Department of Fish and Game Informational Leaflet 12: 35 p.

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